Bulletin of Electrical Engineering and Informatics
Vol. 9, No. 5, October 2020, pp. 2206~2212
ISSN: 2302-9285, DOI: 10.11591/eei.v9i5.2247

Design selective band antenna using coupling sidewall and multi resonator for wireless communications

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Article Info

Article history:

Received Feb 16, 2020
Revised May 4, 2020
Accepted Jun 15, 2020

Keywords:

Resonator
Return loses
Sidewall
Tuned
WBPF

ABSTRACT

Design and simulation of antenna with performance operating at bandwidth (4.5-6.5) GHz, with center frequency 5.5 GHz. This antenna constriction from two cylindrical antenna shapes and four cylindrical resonators with include iris to matching impedance, to enhancement sharp edge band and four tuned between coupling sidewall to removed distortions. Improving the frequency selection of the bandwidth requirement antenna is by adjusting the cylinder length of the antenna The proposed antenna is operating ideal filter because the edge of the band rejection is matched the edge of the bandwidth requirement which makes it perform well including broad edges for the band rejection and sharp edges of the bandwidth requirement together with a little insertion between two types and good return loss of the bandwidth requirement. CST software used to investigate and simulated results.

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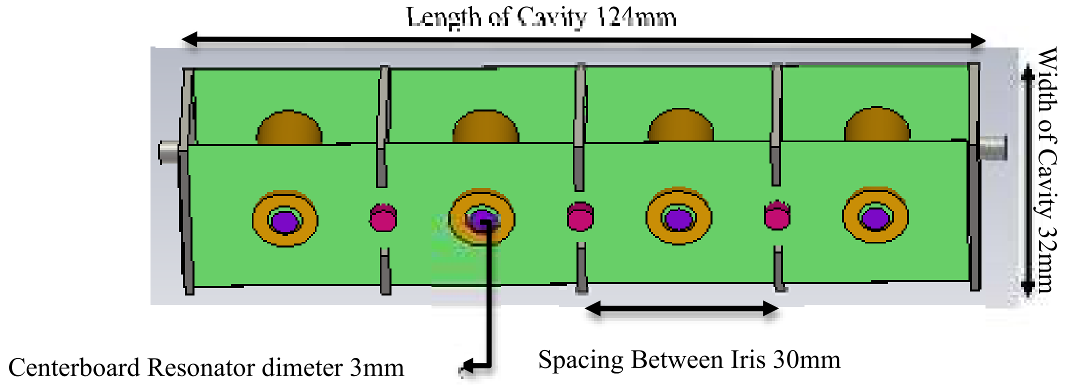
1. INTRODUCTION

Recently, wireless communication devices and systems must be high performance, small in size and easy to use, and they have wide bandwidth, few losses, and high efficiency, as well as the selectivity of radio waves very high [1]. The significant growth and development in modern wireless communications, which has resulted in increased spectrum congestion, which has given great importance to the use of microstrip (Wide-BPF) in its use in communication systems [2]. Usually, the receivers and transmitters operate on more than one band, and therefore the need is necessary for antenna worker a bandpass filter (BPF) that works on a specific bandwidth, which allows the passage of wanted frequencies and prevents other frequencies, so broadband servers can be implemented [3-5]. The second harmonic causes several problems in responding to the filter antenna when using traditional filter antenna designs. Therefore, many filters antenna are designed in different ways that avoid harmonics. When performing a filter antenna, it must have a wideband and the signal selection is very high [6-10].

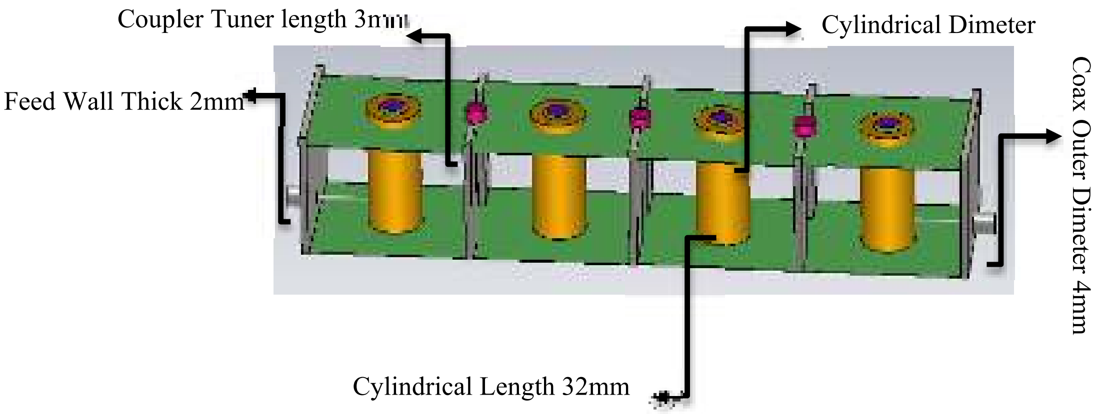
In this work, the antenna is operated a wide passband filter type is proposed, which is characterized by a high selectivity of the required band, which consists of two cylindrical antennas at the two ends of the filter and between them four resonators to improve matching and four tunes for toning and deformation removal, as well as the presence of separating walls between stages that achieve response to bandwidth. It is possible to control the cylindrical tunes and resonators by sending four zeros which give the band a good broad as it works on the upper of the band to improve the selection of the passband as well as they reject of the band stop, and this filter was made of FR4.

2. RESEARCH METHOD

The proposed antenna is shown in Figure 1 is easy to implement, which is represented by a simple, identical size microscope line, easy to build that gives a wide band and is compatible with the bandpass filter and band stop filter and works in WiMAX and WLAN applications. The designed antenna has four identical parallel-coupled cylindrical tuned and resonator at the desired center frequency, three tuners between iris to remove distortion in the cavity model. Table 1 shows the parameter antenna design.



(a)



(b)

Figure 1. The proposed antenna, (a) Perspective, (b) Bottom

Table 1. Parameter filter design

Parameter	Value in (mm)	Parameter	Value in (mm)
LC	124	WC	32
CRD	3	CTL	3
SBI	30	CD	15
COD	4	CL	32
FWT	2		

In this proposed antenna, a multi-mode resonator is used in a multi-cylinder resonator, and you need the first three resonance frequencies. Figure 2(a) shows the open circuit represents steppe impedance for the multi-mode resonator and Figure 2(b) shows transmission line circuit model. In the MCR-based used in proposed filters antenna, the different resonator modes are used, point to form a single WBP. Normalize resonance frequencies against impedance rate ($R=Z_2/Z_1$) of a multi-mode resonator. Such as has always been completed before based on generalized transmission line theory, the multiple-mode property of the MCR can be described simply [11-15]. Figure 2(b) the total transmission line circuit model, where the terminal ends of this multiple-mode resonator MMR are both open circuit [16, 17].

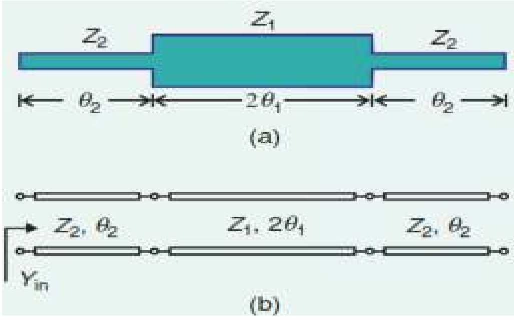


Figure 2. (a) The open circuit represents the steppe impedance multimode resonator,
(b) The total transmission line circuit model

Can be derived the input admittance (Y_{in}) in the following [18-25]:

$$Y_{in} = jY_2 \frac{2(R\tan\theta_1+\tan\theta_2)(R-\tan\theta_1\tan\theta_2)}{R(1-\tan^2\theta_1)(1-\tan^2\theta_2)-2(1+R^2)\tan\theta_1\tan\theta_2} \quad (1)$$

where ($R=Z_2/Z_1$) is the impedance ratio.

At the resonances, we have:

$$Y_{in}=0 \quad (2)$$

From (1) and (2), can be determined a group of resonance frequencies ($f_1, f_2, \ldots$) from θ_1 and θ_2. In the case of $\theta_2 = 2\theta_1 = \theta$ we have:

$$\theta(f_1) = \tan^{-1}\sqrt{\frac{R}{R+2}} \quad (3)$$

$$\theta(f_2) = \tan^{-1}\sqrt{\frac{R+2}{R}} \quad (4)$$

$$\theta(f_3) = \frac{\pi}{2} \quad (5)$$

Therefore,

$$\frac{f_2}{f_1} = \frac{\theta(f_2)}{\theta(f_1)} = \frac{\tan^{-1}\sqrt{\frac{R+2}{R}}}{\tan^{-1}\sqrt{\frac{R}{R+2}}} \quad (6)$$

$$\frac{f_3}{f_1} = \frac{\theta(f_3)}{\theta(f_1)} = \frac{\pi}{2tan^{-1}\sqrt{\frac{R}{R+2}}} \quad (7)$$

In the analysis for the case of $\theta_2 = \theta_1 = \theta$, can be obtained from (3-7) respectively.

$$\theta(f_1) = \tan^{-1}\sqrt{R} \quad (8)$$

$$\theta(f_2) = \frac{\pi}{2} \quad (9)$$

$$\theta(f_3) = \pi - \tan^{-1}\sqrt{R} \quad (10)$$

$$\theta(f_4) = \pi \quad (11)$$

Therefore,

$$\frac{f_2}{f_1} = \frac{\pi}{2\tan^{-1}\sqrt{\frac{R}{R+2}}} \quad (12)$$

$$\frac{f_3}{f_1} = \frac{\pi}{\tan^{-1}\sqrt{\frac{R}{R+2}}} - 1 \quad (13)$$

$$\frac{f_4}{f_1} = \frac{\pi}{\tan^{-1}\sqrt{R}} \quad (14)$$

These three normalized frequencies in (12-14) are similar when used the case $\theta_2 = 2\theta_1 = \theta$, the fourth frequency is distinguished from the first three frequencies of the resonance, where the first frequencies are close to each other by increasing the resistance.

3. RESULT AND DISCUSSION

The antenna is operated filter to select band WiMAX and WiLAN require can be obtained. To achieve a narrow coupling, a slot width in the resonator must be reduced. A parallel coupling microstrip line (PCML) has been used extensively in the multi-stage design of the bandwidth requirement.

Figure 3 shows the simulation result of S_{11} represents the bandpass filter at the bandwidth (4.5-6.5) GHz to have center frequency 5.5 GHz, and S_{21} represents the ideal bandstop filter for the bandwidth requirement.

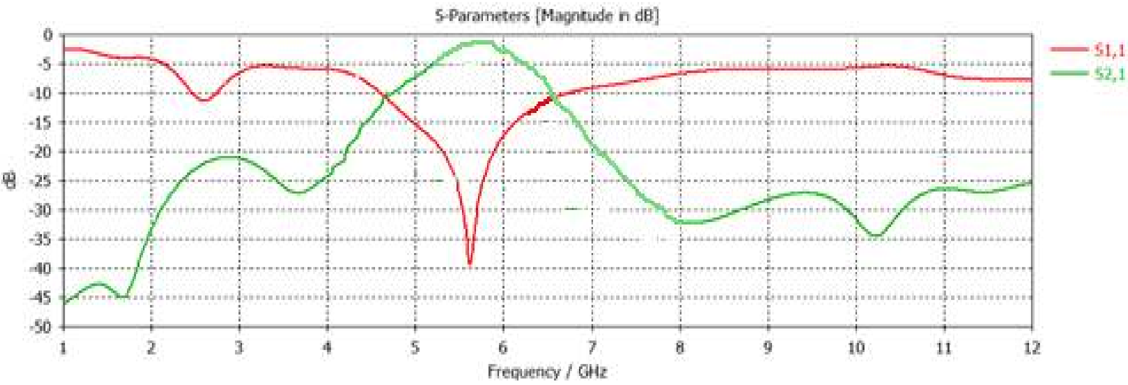


Figure 3. Simulated frequency response of S_{11} and S_{21}

Figure 4 shows the group time delay of the antenna designed should be able to transmit the electrical pulse with minimum distortion is calculated of the proposed filter is around to zero with variation is (0 to -2) nsec due the bandwidth frequency (4.5-6.5) GHz and the voltage standing wave ratio (VSWR) is also less than ≤ 2 as shown in Figure 5 so that the VSWR is the ratio of maximum voltage or current to minimum voltage or current at any point it considers as measure for the mismatch between the line and the load.

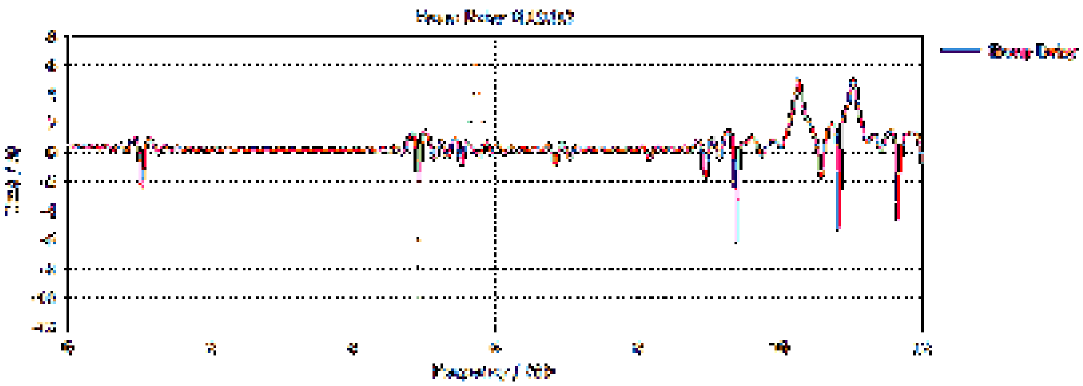


Figure 4. Group delay at frequency 5.5GHz

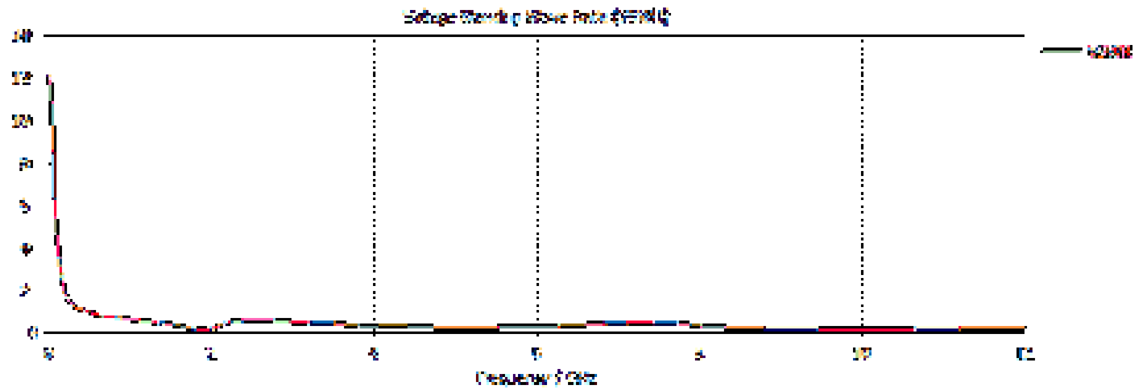


Figure 5. Voltage standing wave ratio at 5.5 GHz

Figure 6 shows the real filter input impedance value equal to 50 ohms at 5.5 GHz and Figure 7 shows the imaginary filter input impedance value equal zero at 5.5 GHz. The gain at the frequency resonance requirement is 7dBi as shown in Figure 8. The radiation pattern is stable at 5.5 GHz where the frequency bandwidth changes with nearly omnidirectional radiation pattern. Figure 9 show the simulated radiation pattern in E-plan and H-Plan for the frequency requirement, show good approval. Both planes for the antenna show two independent orthogonal linear polarizations so the separation two directions (X and Y). Nearly good omnidirectional patterns have been observed.

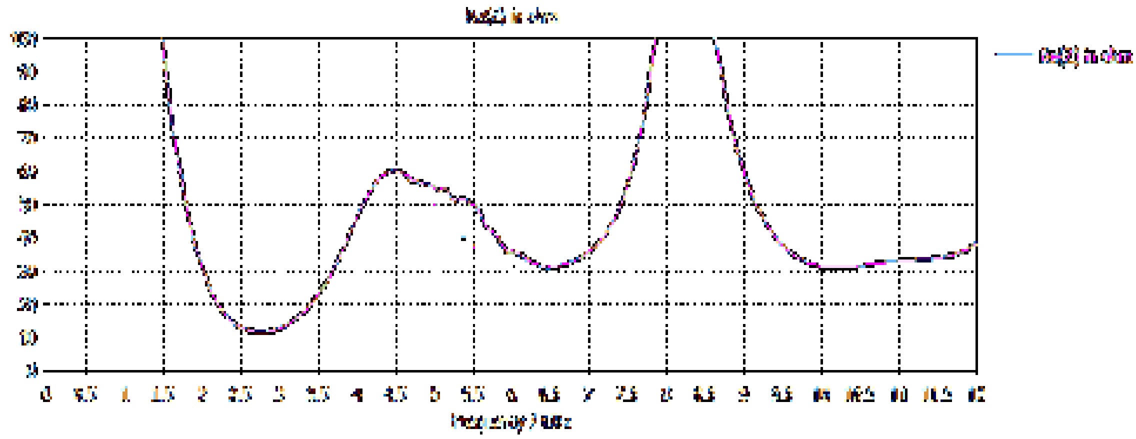


Figure 6. The real impedance value at 5.5GHz

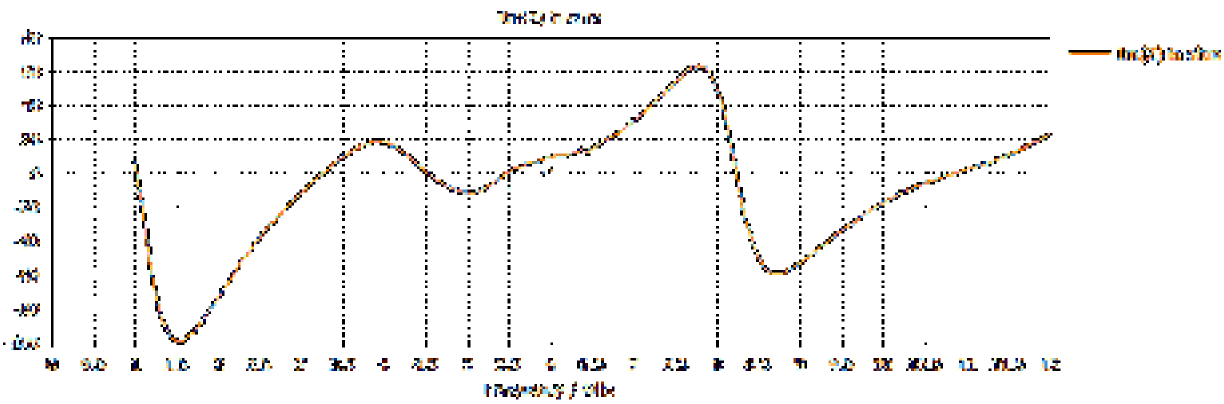


Figure 7. The imaginary impedance value at 5.5GHz

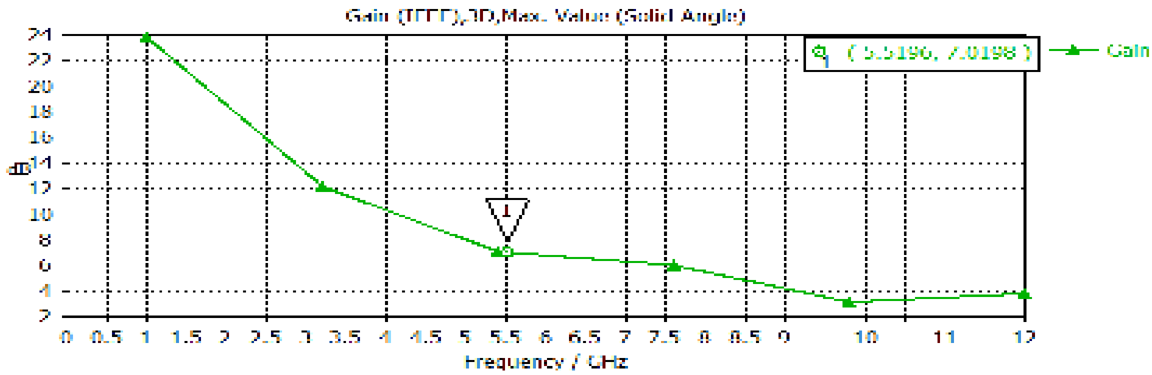


Figure 8. The gain value at 5.5 GHz

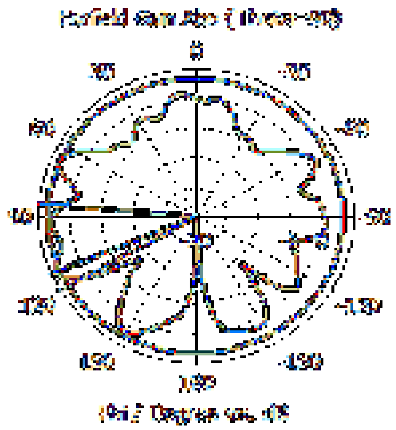


Figure 9. The radiation patterns of proposed filter antenna in E-plane & H-plane at f=5.5 GHz

4. CONCLUSIONS

Antenna design with an inserted bandwidth from selective frequency is given to (4.5-6.5) GHz with frequency center 5.5 GHz. The antenna proposed size is (124×32 ×32) mm. The simulation results of the reflection coefficient of the proposed antenna are -38dB return-loss at the bandwidth requirement and co-reflection coefficient for the band-reject -1dB, at the WiMAX and WLAN application. The proposed antenna effectively addresses frequency interference problems and has comprehensive properties in coverage in all directions as well as stable and stable characteristics in the reception and transmission of signals and can be built and designed easily and its properties can be modified with high flexibility and that this antenna is operated filter is compatible with WiMAX and WLAN applications.

ACKNOWLEDGMENTS

The authors acknowledge support from the authority of Mustansiriyah University. The authors would like to give special thanks to the anonymous referee for suggesting several pertinent issues that have enabled us to improve the manuscript substantially.

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